Space Weather Technical Forecast

Issued on Tuesday, 02 April 2024 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Flare activity declining, with a decreased chance of M-flares. Active to G1 Minor Storm intervals likely into Day 2 (03 Apr) due to the expected arrival of CH16/CH17 fast wind.

Analysis of Space Weather Activity over past 24 hour

Solar Activity: Activity has been Moderate with a double peaked M3.9 at 01/0132 UTC (and M3.3 at 01/0142 UTC). This appeared to be a dual flare, comprising components from AR3625 in the northwest and the recently departed AR3615 from over the southwest limb. There four simple sunspot regions on the disc. The only notable recent sunspot development on the Earth-side was the emergence of a region, AR3625, near the northwest limb. This region was implicated in the recent M-flare, but this may have been sympathetic flaring with the recently departed AR3615. Overall, it looks a fairly straightforward region, although its proximity to the limb means we are unable to see the finer detail in its magnetic structure.

No Earth-directed CMEs were observed in available imagery although a CME emerging to the southwest in recent coronagraph imagery has an uncertain source and is under investigation.

Solar Wind / Geomagnetic Activity: Ongoing fast wind conditions were observed, likely from some combination of CH15/+ and CH13/+. Solar wind speeds measured by ACE/DSCOVR at L1 were slightly elevated to elevated, mostly varying between 450-520 km/s. Density was below average. Total Interplanetary Magnetic Field (IMF), Bt, was weak to moderate, peaking near 10nT between to start the period. The north-south component, Bz, varied mostly weakly between +7/-7nT. Phi angle remained mostly positive (away from the Sun), with some negative variation. Geomagnetic activity was Quiet to Unsettled (Kp1-3) but with one Active (Kp4) interval 01/0600-0900 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES-18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The associated 24-hour fluence remained below Active, with a value of 1.94e6 integrated pfu at 02/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is expected as the recently departed AR3615 rotates well onto the far-side with only smaller sunspot regions currently on the disc. A very slight chance of isolated M-flares, both initial and increasing by the end of the period.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, although this is only moderate confidence with a small chance of a glancing arrival on Day 2 (02 April) from a weak CME that left the Sun on 29 Mar.

Otherwise current elevated wind speeds, most likely due to positive coronal hole influence from CH15/+ or CH13/+, may gradually ease through Day 1 (02 Apr). The next enhancement, from

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the combined influence of CH16/- and CH17/- is then expected into Day 2 (03 Apr) with any enhancement expected to continue through Day 3 (04), perhaps gradually easing by Day 4 (05 Apr).

Geomagnetic activity is forecast to be mainly Quiet on Day 1 with a chance of Unsettled to Active intervals from current fast wind or possible glancing CME influence. Activity then increasing to become Active with a chance of G1 Minor Storm intervals due to the fast wind onset Day 2 and perhaps early Day 3, before easing to Quiet to Unsettled with a chance of Active intervals.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18, is expected to be near background levels, but with a very slight chance of enhancement Day 1 (02 Apr) given any strong flares from the recently departed AR3615. High energy electron flux is expected to persist at background levels until after the next fast wind enhancement on Days 3-4 (04-05 Apr). The associated fluence will persist below the Active threshold, but with a slight chance of rising above by the end of Day 4.

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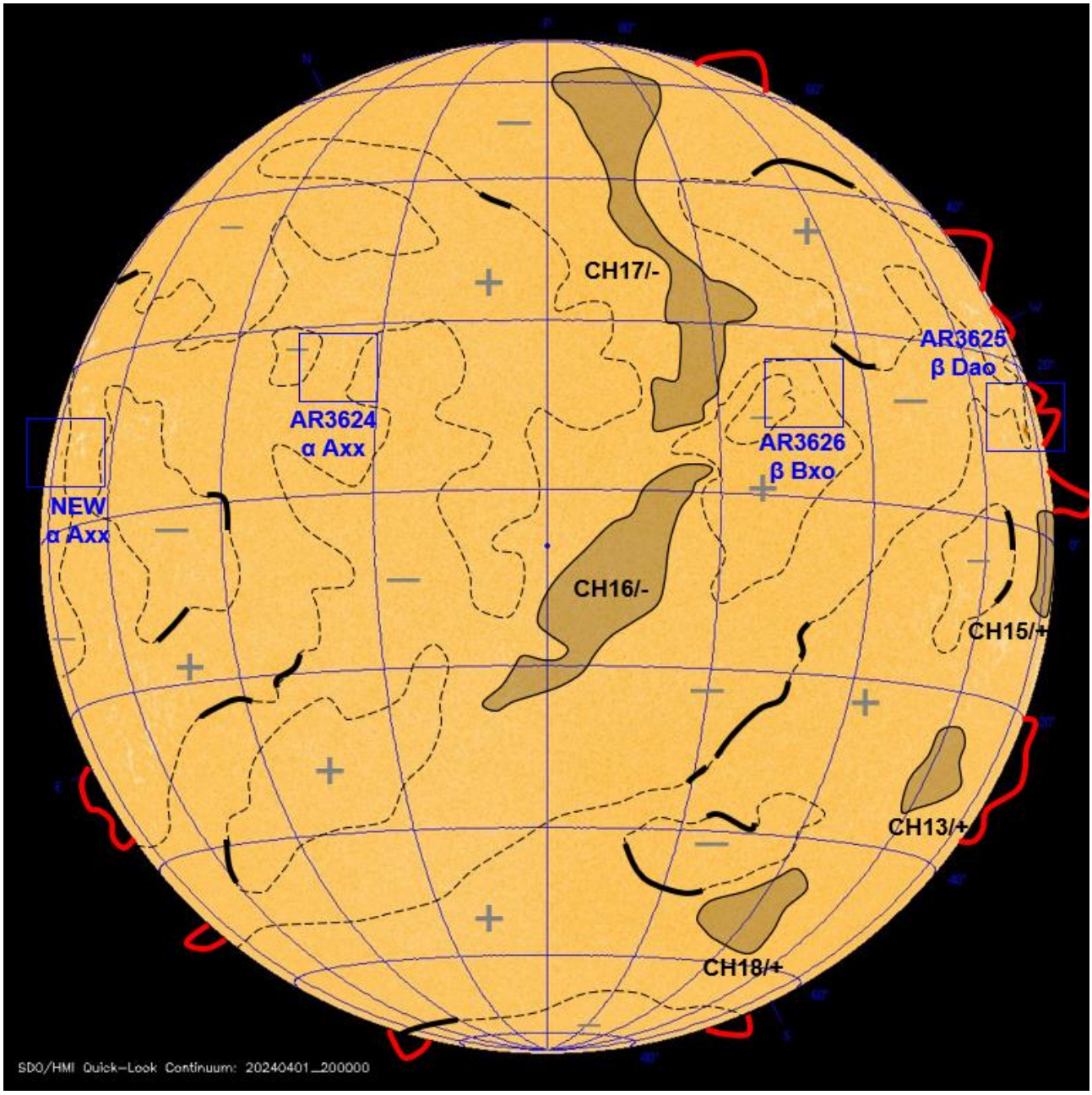
Figure 1. Solar Analysis Valid 01/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs currently expected, however this is only moderate confidence. This is due to the potential for a very slight glancing interaction from a CME which left the southwest disc on 29 Mar, with a weak enhancement possible on Day 1 (02 Apr). Earth is currently seeing fast wind influence most likely from positive polarity CH15/+ and/or CH13/+. These winds may erratically ease through Day 1 (02 Apr) before the onset of a further coronal hole fast wind from negative polarity CH16/- and CH17/-. These are recurrent features, but much more prominent on this rotation. They are also more likely to give a geomagnetic response at this time of year than the current (positive) fast wind due to their negative polarity. An earlier arrival is expected compared to that indicated in either ENLIL model output or 27-day persistence, more likely early on Day 2 (03 Apr). Ongoing fast wind effects are then expected into Day 3 (04 Apr), before perhaps easing later into Day 4 (05 Apr).

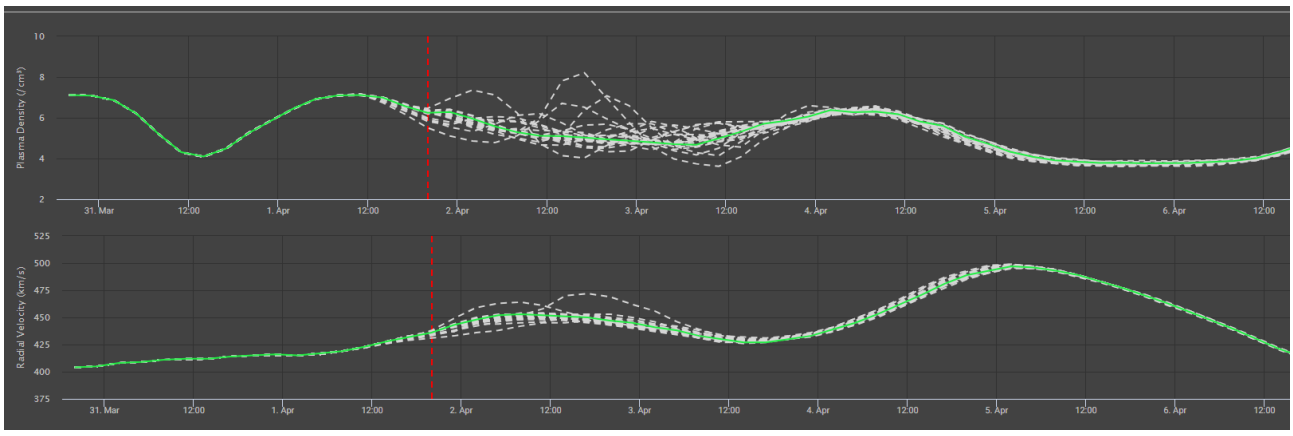
Geomagnetic activity is forecast to be mainly Quiet on Day 1 with a chance of Unsettled to Active intervals from current fast wind or possible glancing CME influence. Activity then increasing to become Active with a chance of G1 Minor Storm intervals due to the fast wind onset Day 2 and perhaps early Day 3, before easing to Quiet to Unsettled with a chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	50	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Very low risk of some Earth directed influence on 02 April.

Figure 2: Latest ENLIL Ensemble data showing potential for slight glancing CME influence Day 1 and expected HSS onset. Note ENLIL expected to have this onset delayed compared to reality based on analysis.



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Radio Blackouts - X-Ray Flares:

The flare risk from the recently departed AR3615 is now declining, though the magnetic looping of the spot is still just about visible over the southwest limb its contribution to the total flare risk will soon disappear as it moves further away from the limb though Day 1 (02 Apr with currently little activity to replace it on the visible disk.

The only notable recent sunspot development on the Earth-side was the emergence of a small region, AR3625, near the northwest limb. This region was implicated in the double peak flare earlier on the 31st, but this may have been sympathetic flaring with AR3615. Overall, it looks a fairly straightforward region, although its proximity to the limb means we are unable to see the finer detail in its magnetic structure. Ex-AR3612, which developed near the northwest limb around 14 days ago, and produced an M-flare as it rotated off, has the potential to return onto the northeastern limb by Day 2 (03 Apr). There are some indications of magnetic strength in a similar location on far-side helioseismic imagery, however this is low confidence.
Low activity is expected, with a very slight chance of isolated M-flares, both initial and increasing by the end of the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	10	5	10	15
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux observed by GOES-18 is now at background levels, and none of the visible spots are currently expected to produce proton rich flares.

The main risk of any enhancement to the proton flux is from AR3615, which is now over the southwest limb and moving further onto the far-side. Significant flares from this region are still possible, and could still result in protons redirected towards Earth along the Parker Spiral. If such an enhancement was to occur on Day 1 (02 Apr), any increase to proton counts could persist for a few days. The likelihood for onset of such an event is expected to decline Day 2 onward.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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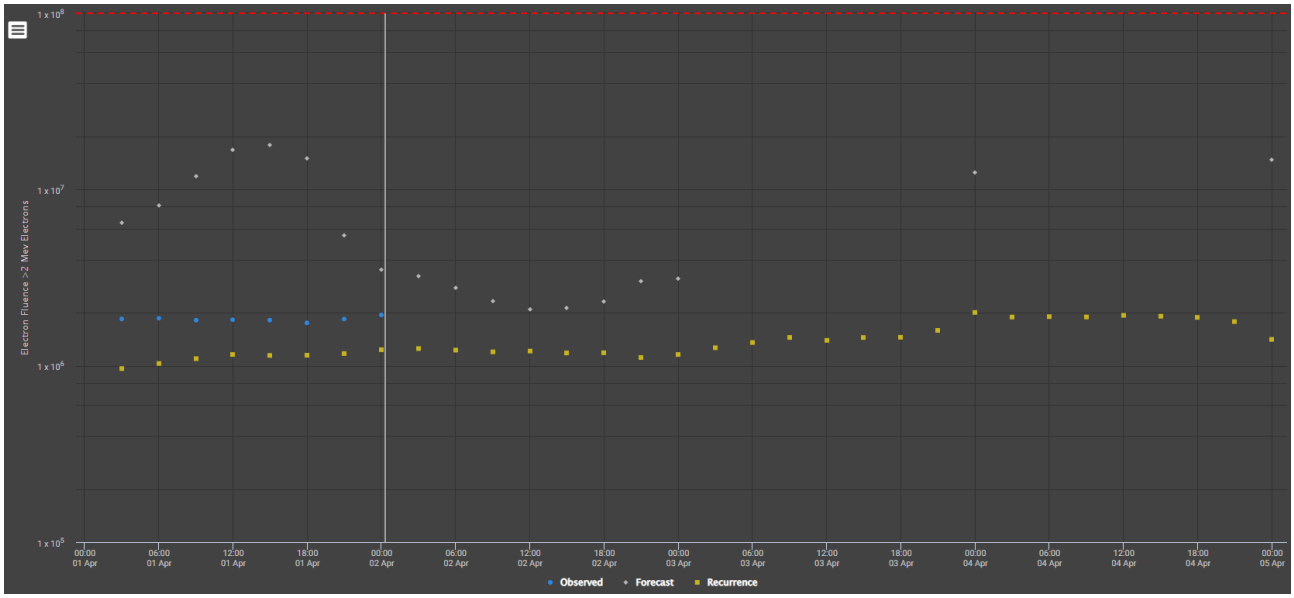
High Energy Electrons Event (≥ 2MeV):
GOES-16 high energy electron flux at GEO has persisted at background levels, with no significant enhancements expected until the onset of any fast wind from CH16/17. Electron count rates perhaps climbing as a response into day 3 or more likely Day 4 (04-05 Apr), potentially reaching Moderate to High levels by the end of the period as coronal hole influence likely fades.

The associated 24 hour fluence is expected to remain steady, well below the Active (1e8 integrated pfu) level, on Days 1-3, before rising gradually through Day 4. This will bring a slight chance of reaching the Active threshold by the end of the period, but most likely to occur beyond this period. REFM is providing a good guide to current conditions, however it is unlikely to forecast any increase in fluence until after the fast wind arrives at Earth.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output



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